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# **US ARMY PUBLIC HEALTH COMMAND**

(Provisional)



## **WIPE SAMPLE INTERPRETATION**

**E2S2 Conference**

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**USAPHC**

Environmental Health Risk Assessment Program



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# Purpose

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- Describe the rationale and logic used to assess health risks associated with chemical contamination on indoor surfaces
- USAPHC developed TG 312 for *office environments*
- Will not address issues related to collecting a “good” wipe sample



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# Background and Scope

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- Few published health-based wipe sample standard/guidelines
- The development of TG 312 was an evolutionary process over time
- Guide is written in two parts;
  - First part basic concepts/explanation for general preventive medicine community
  - Second part detailed discussion of methodology for health risk assessors



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# Evolution of Technical Guide 312

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- Pesticide residues at military housing
- Johnston Atoll Chemical Agent Disposal System (JACADS)
- Developed screening levels for construction/demolition workers
- Research laboratory converted to office
- Explosive residues in storage buildings
- Past herbicide research in laboratory



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- Contrast the health risk interpretation:
  - Drinking water
  - Food consumption
  - Surface wipe samples
- Basic EPA Risk Methodology equates health risk to magnitude of chemical intake.
- How to estimate an Average Daily Intake (ADI) from available environmental data?



# EPA Health Risk Fundamentals



Health Effects	Human Health	Formula
Cancer risk	<b>ILCR</b> (Incremental Lifetime Cancer Risk)	$\text{ILCR} = \text{Chemical Intake} \times \text{Cancer Slope Factor}$
Noncancer	<b>HQ</b> (Hazard Quotient)	$\text{HQ} = \frac{\text{Chemical Intake}}{\text{Reference Dose}}$



# Cancer Example

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ILCR = chemical intake X cancer slope factor

example:

A person incidentally ingesting sediment containing arsenic with a calculated intake of 7.23E-08 mg/kg-day



$$7.23\text{E-}08 \text{ mg/kg-d} \times 1.5 (\text{mg/kg-d})^{-1} = \mathbf{1.08\text{E-}07}$$



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# Non Cancer Example- HQ

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example:

A worker incidentally ingests surface water with a calculated intake of  $3.66\text{E-}07$  (mg/kg/day) of thallium



$$\text{HQ} = \frac{3.66\text{E-}07 \text{ (mg/kg/d)}}{7.00\text{E-}05 \text{ (mg/kg/d)}}$$

$$\text{HQ} = 5.2 \text{ E-}03$$



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# Drinking Water Example

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- Measure chemical concentration
- Estimate daily water intake
- Concentration x consumption = mg



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# Food Consumption

## Example

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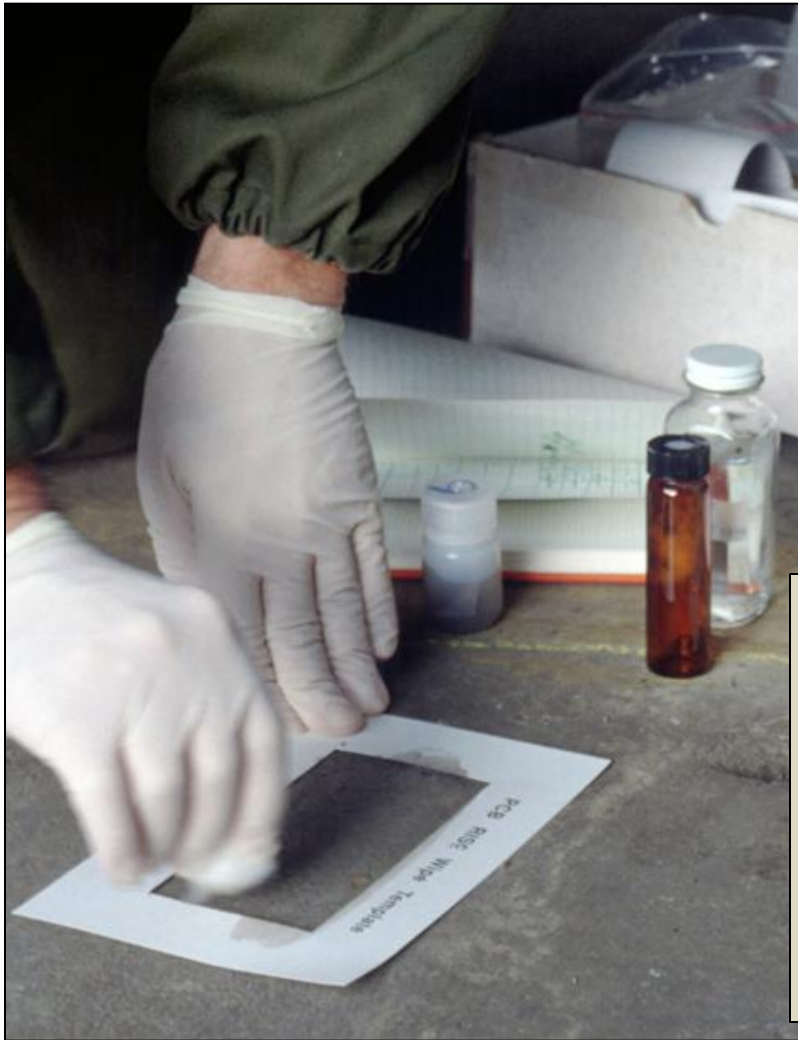


- Measure concentration in fish tissue
- Estimate fish consumption
- $\text{Concentration} \times \text{consumption} = \text{mg}$



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# Wipe Sample Example



- Assume perfect sampling results of  $50\mu\text{g}/100\text{ cm}^2$
- How do we use this surface sampling information to estimate intake?





# Sampling Scenario

## Child Day Care Center

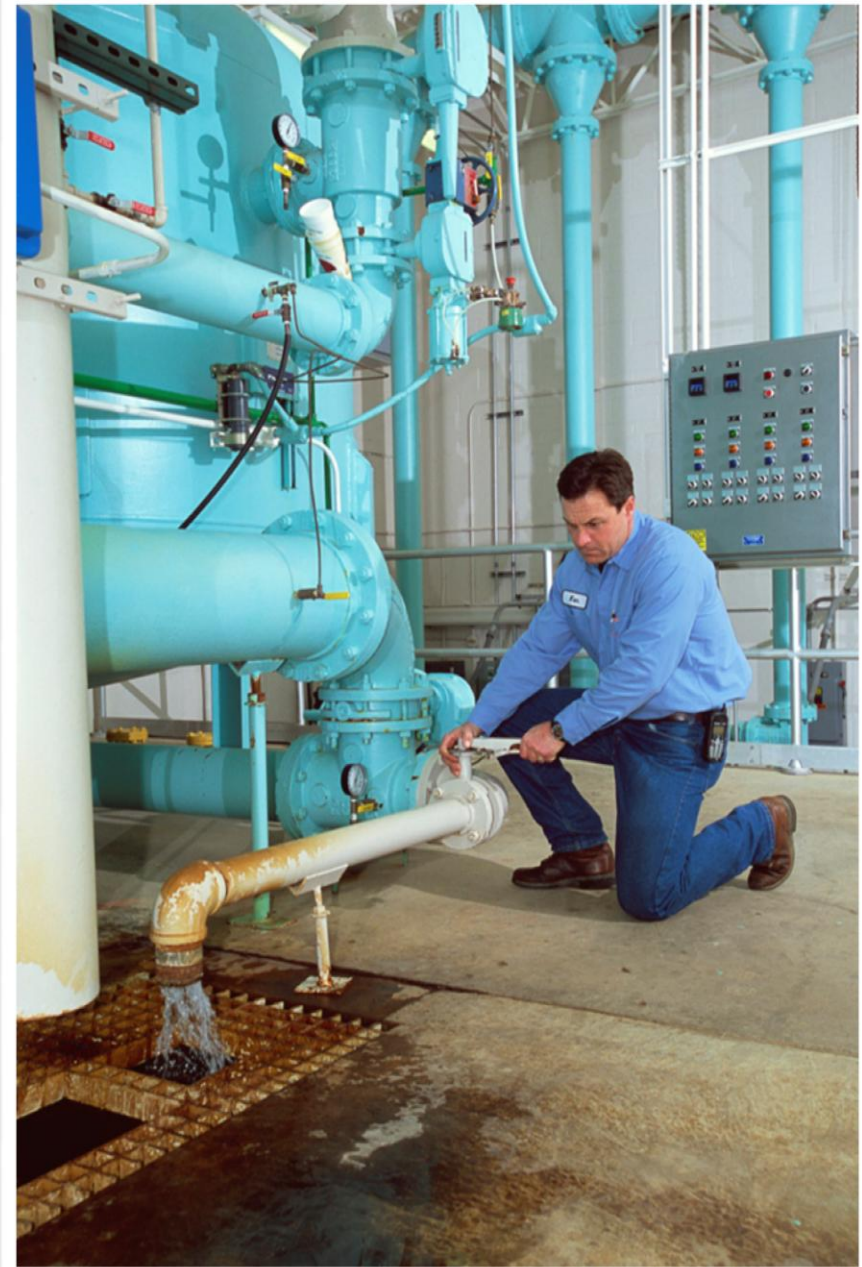


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# Sampling Scenario

## Locked Mechanical Room



# Potential Exposure Pathways



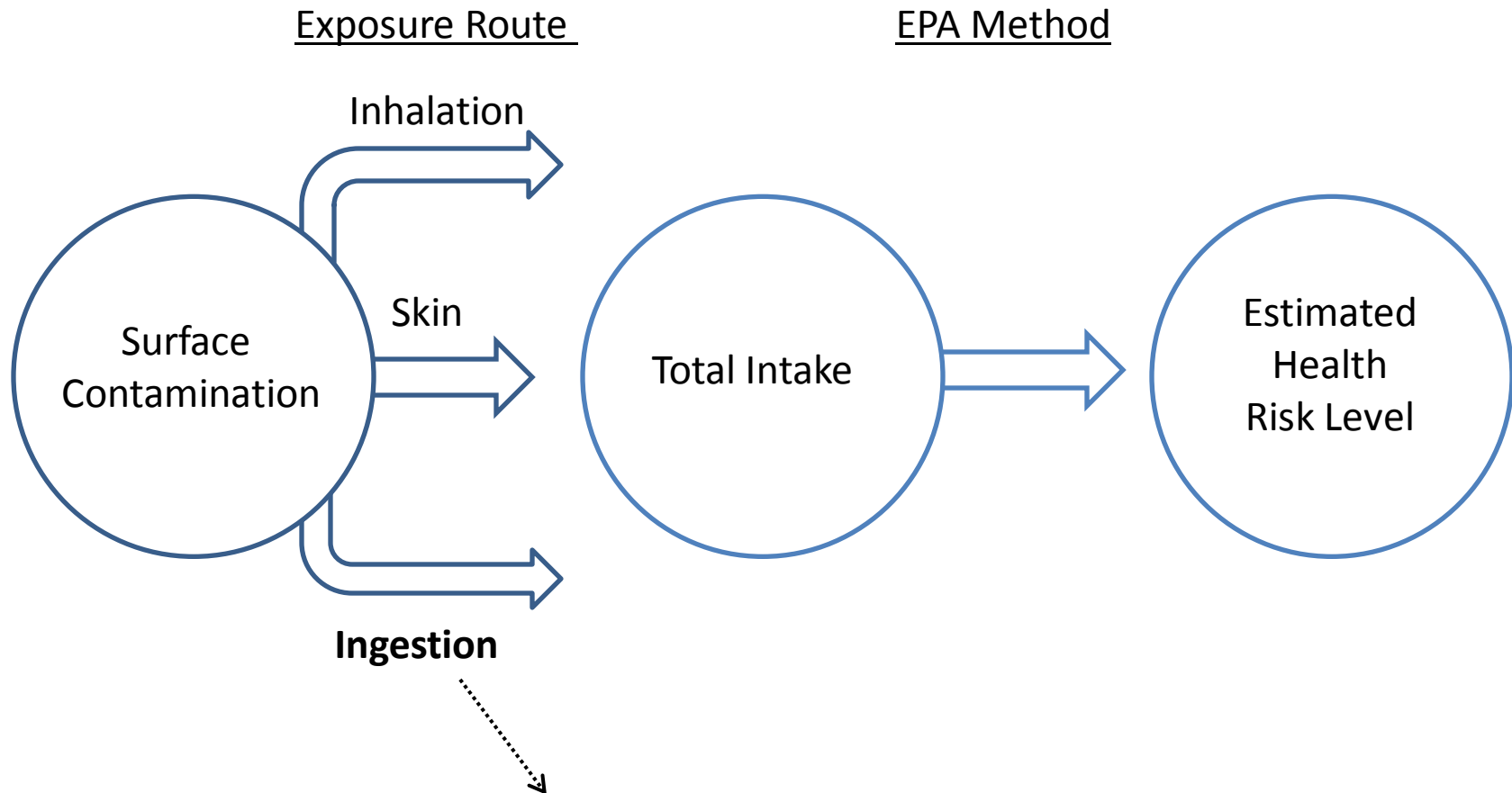
- ✓ Direct dermal contact
- ✓ Indirect ingestion from “mouthing behavior”
- ✓ Inhalation of settled particles resuspended from surface
- X Inhalation of semi-volatiles absorbed to surfaces (e.g., laminated, plastic)





# Wipe Sample Interpretation

## Exposure Assessment



$$ADI_{ing} = \frac{(SA \times Fd \times FT_{ss} \times Cs \times Ff \times FT_{sm} \times EV_{ing}) \times EF \times ED \times 10^{-3}}{BW \times AT}$$





# Incidental Ingestion (fingers)

$$PD_{\text{ingestion (fingertips)}} = SA \cdot Fd \cdot FT_{ss} \cdot C_s \cdot F_f \cdot FT_{sm}$$

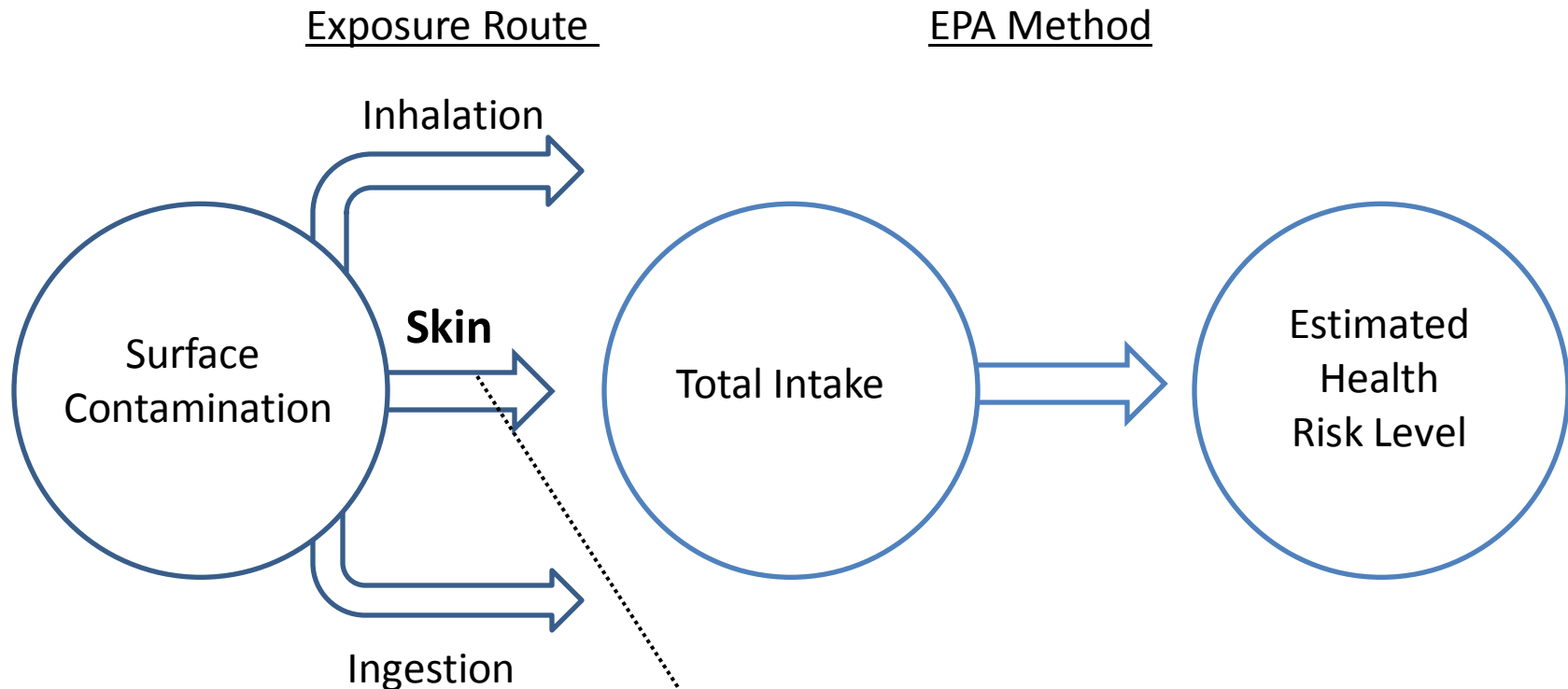
$PD_{\text{ingest}}$	Potential ingestion dose (mg/event)
SA	Exposed skin surface area per event (cm <sup>2</sup> /event)
Fd	Fraction exposed skin surface area that actually contacts the surface (unitless)
$FT_{ss}$	Fraction transferred from surface to the skin (unitless)
$C_s$	Contaminant surface loading (mg/cm <sup>2</sup> )
$F_f$	Fraction exposed skin area that contacts the mouth (unitless)
$FT_{sm}$	Fraction substance transferred from the skin to mouth (unitless)





# Wipe Sample Interpretation

## Exposure Assessment

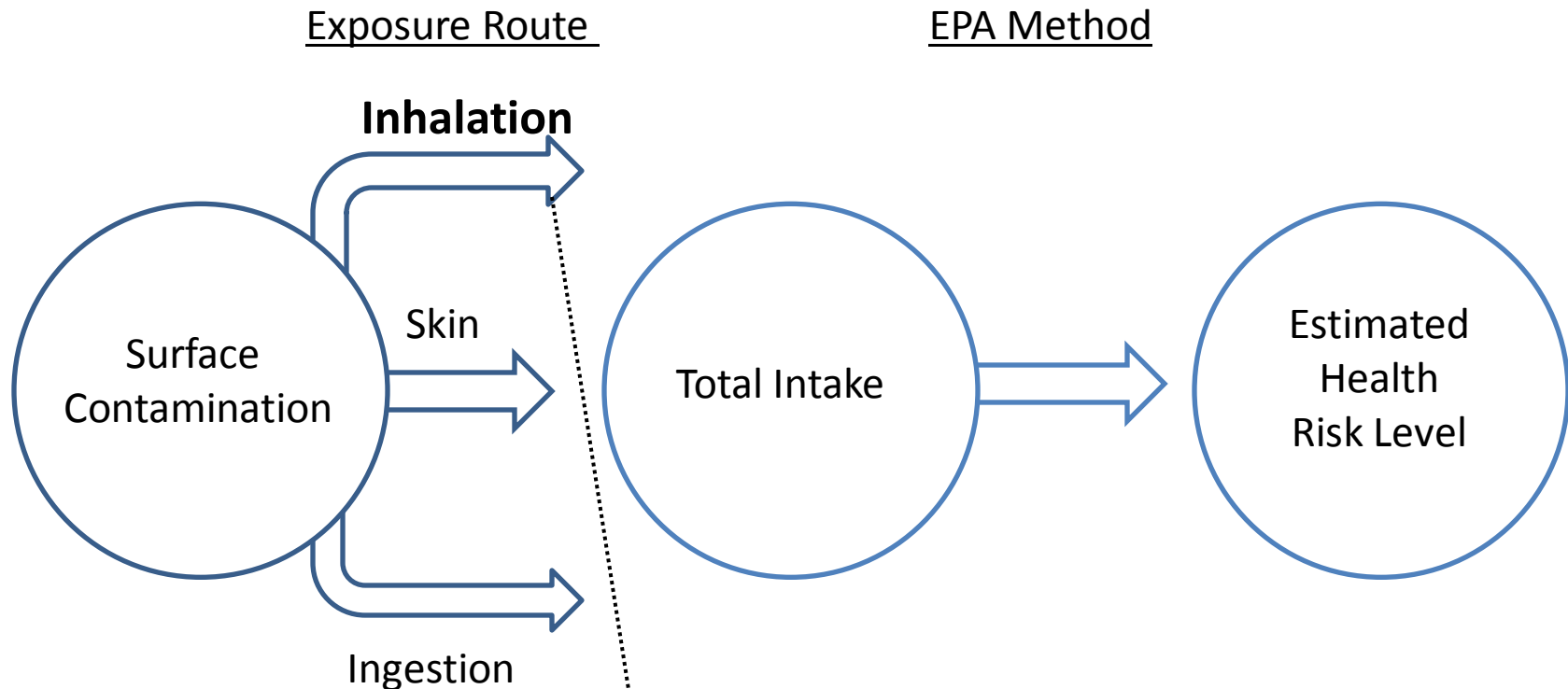


$$ADI_{\text{derm}} = \frac{\sum (SA_i \times Fd_i) \times FTss \times Cs \times ABS \times EV_{\text{derm}} \times EF \times ED \times 10^{-3}}{BW \times AT}$$



# Wipe Sample Interpretation

## Exposure Assessment



$$ADI_{inh} = \left( \frac{f_{resp} \times C_s \times 10^4 \times A_s \times R}{V(\lambda_{dep} \times \lambda_a)} \right) \times \frac{IR_{inh} \times ET \times EF \times ED \times 10^{-3}}{BW \times AT}$$

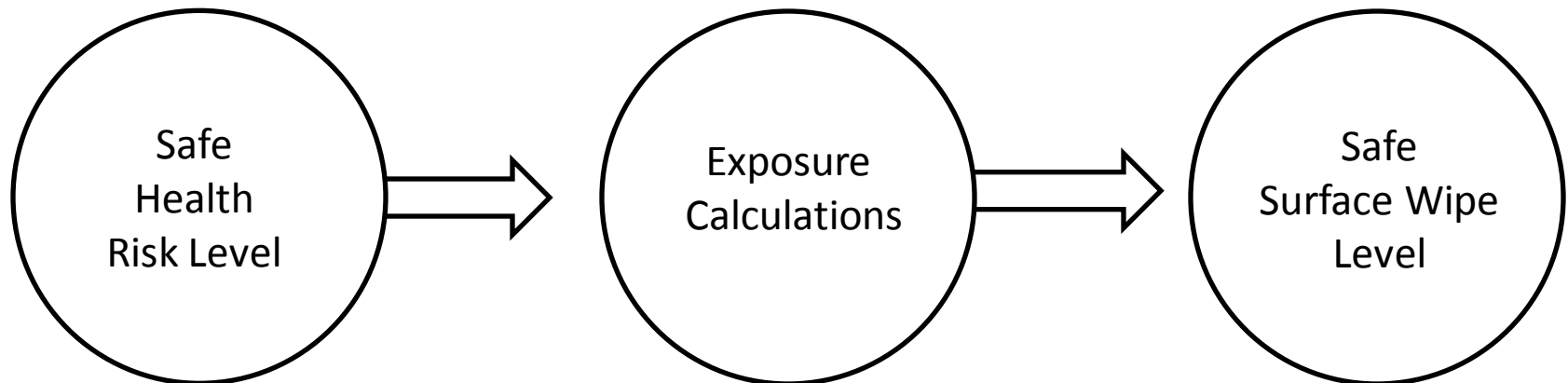
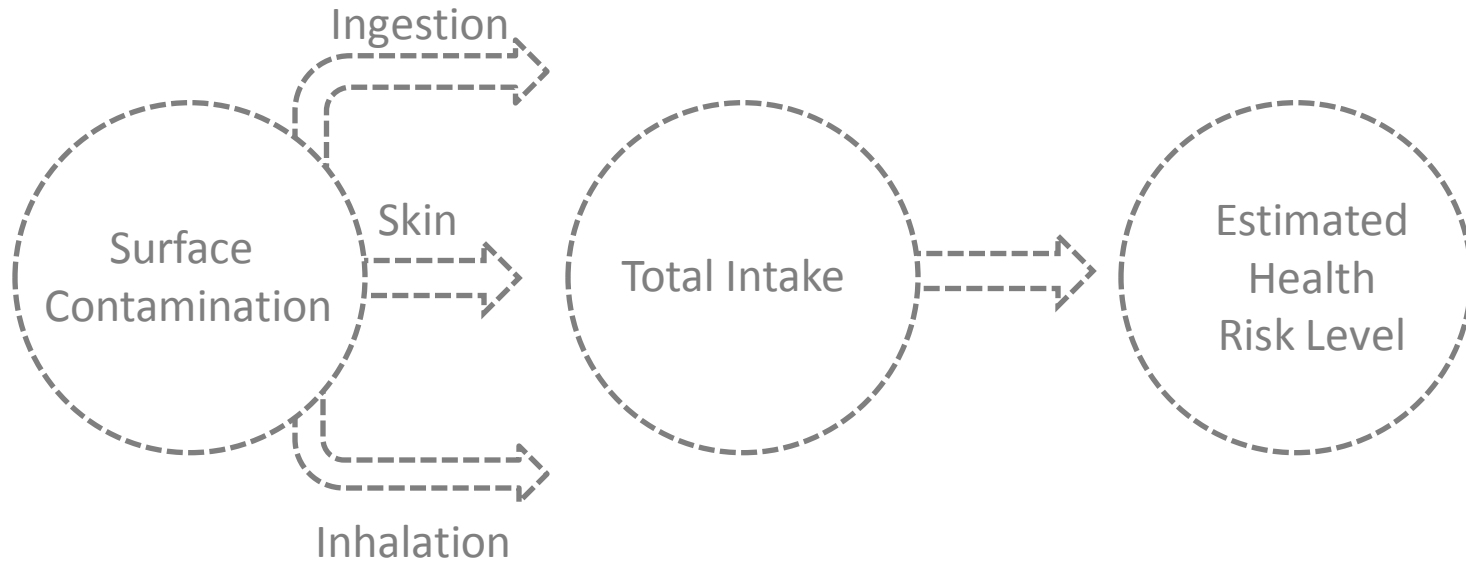


# Wipe Sample Interpretation

## Safe Wipe Level Calculation

Exposure Route

EPA Method





# Wipe Sample Interpretation

## Example Comparisons

Substance	Source	Safe level (ug/100 cm <sup>2</sup> )
Beryllium	DOE	3 and 0.2
	TG 312	4.7
PCB	TSCA EPA	10
	TG312	1.60 and 9.04
	Michaud et al.	7.5
2,3,7,8 TCDD	EPA WTC	0.00002
	TG312	0.0000354
	Michaud et al.	0.00125





# Wipe Sample Interpretation

## References

Michaud, et al (1994) "PCB and Dioxin Re-Entry Criteria for Building Surfaces and Air", Journal of Exposure Analysis and Environmental Epidemiology, Vol 4, No. 2.

Contaminants of Potential Concern Committee (2003) "World Trade Center Indoor Environment Assessment: Selecting Contaminants of Potential Concern and Setting Health-Based Benchmarks".

USACHPPM, (2009) Technical Guide 312 Health Risk Assessment Methods and Screening Levels for Evaluating Office Worker Exposures to Contaminants on Indoor Surfaces Using Surface Wipe Data.





# Wipe Sample Interpretation

## References (cont)

Department of Energy, 10 CFR Part 850, Chronic Beryllium Disease Prevention Program; Final Rule

Toxic Substance Control Act, PCB Regulations: 40 CFR Part 761.61, PCB remediation waste.

Nicas, M Et al (2008) "A Study Quantifying the Hand-to-Face Contact Rate and Its Potential Application to Predicting Respiratory Tract Infection", Journal of Occupational and Environmental Health.





# Acknowledgements

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# Backup Slides



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# Inhalation of Resuspended Surface Particles

$$C_{air} = \frac{f_{resp} \cdot C_s \cdot 10^4 \cdot A_s \cdot R}{V \cdot \lambda_{dep} + V \cdot \lambda_a}$$

$C_{air}$	Resuspended air concentration (mg/m <sup>3</sup> )
$C_s$	Contaminant surface loading (mg/cm <sup>2</sup> )
$f_{resp}$	Fraction respirable (unitless)
$10^4$	Units conversion, cm <sup>2</sup> to m <sup>2</sup>
$A_s$	Source area (m <sup>2</sup> )
$V$	Room volume (m <sup>3</sup> )
$R$	Resuspension rate (1/hr)
$\lambda_{dep}$	Deposition loss rate (1/hr)
$\lambda_a$	Air exchange rate (air changes per hour [ACH])





# Direct Dermal Contact

$$PD_{dermal} = \left[ \sum_{i=1}^n SA_i \cdot Fd_i \right] \cdot FT_{ss} \cdot C_s$$

$PD_{dermal}$	Potential dermal dose (mg/event)
$SA_i$	Exposed skin surface area per event (cm <sup>2</sup> /event)
$Fd_i$	Fraction exposed skin surface area that actually contacts the surface (unitless)
$i$	Body part in contact with the surface (e.g., hand, forearm)
$n$	Total number of body parts in contact with the surface
$FT_{ss}$	Fraction transferred from surface to the skin (unitless)
$C_s$	Contaminant surface loading (mg/cm <sup>2</sup> )

